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A petro-structural review of the Zermatt-Saas Fee zone

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The Zermatt-Saas Fee zone (ZSZ) is an imbricate of fragments of blueschist- to eclogite-facies metabasalts and metagabbros, serpentinites and mélange zones containing blocks of the above mentioned rocks. The ZSZ is usually interpreted as a fragment of oceanic crust belonging to the Piemont-Ligurian (Tethyan) Ocean that was accreted into the Alpine nappe pile. In the last decades the discovery of several Ultra-High Pressure (UHP, >2.7 GPa at 550-600 °C from coesite bearing eclogites and diamond-bearing fluid inclusions in garnet) localities lead to the interpretation of deep subduction (> 100 km) of the ZSZ in the Eocene, and subsequent uplift from mantle depth with high exhumation rates (e.g. Amato et al., 1999). However, these high pressures are in apparent contrast to the regional metamorphic conditions that reflect pressures peaking at < 2 GPa for 550-600°C (blueschist and eclogite mineral assemblages in mafic rocks). These latter metamorphic conditions do not need anomalous high burial histories and exhumation velocities higher than the plate velocities. The magnitude and distribution of pressure in the tectonic units of the ZSZ are important for constraining dynamic models for the evolution of the ZSZ and the Western Alps.
Before entering into dynamic models, we propose a petro-structural overview where the published petrological data on pressure and temperature are critically reviewed, and positioned on a geological map and cross section in order to integrate them into the proper structural and tectonic framework. The questions we seek to answer are: How is the pressure distributed within the main tectonic units and within the entire ZSZ? Do we observe sharp or gradual pressure gradients within the ZSZ? Can the UHP conditions be averaged/extended to the entire ZSZ? If not, do they correspond to conditions of observable subunits, or do they reflect anomalies in the pressure field? Answering these questions is fundamental to better understand the thermobarometric evolution patterns of the ZSZ, to properly evaluate the geodynamic mechanism of accretion of oceanic crust into orogens, and to better understand the formation of tectonic nappes in general.